determined from data including its production, that is, the number of ingots to be heated per hour, the time required for their reheating and their arrangement upon the hearth of the furnace.

The distance from the hearth to the roof of the furnace will be established by keeping the following fa'cts in mind: sufficient space must be provided to obtain complete combustion of the hot gases, and constant contact of the hot gases with walls or material at a high temperature is an essential condition. A very serious fault of many furnace designs is the premature cooling of the flame or burning gases by directing them in such a manner that they impinge upon cold ingots or other cold material. On the other hand, it would serve no useful purpose to make the chamber too large, but it is desirable to make the roof of sufficient height to give the hot gases of the flame a sufficient time to complete their reaction before they come in contact with bodies sufficiently cold to impede or prevent the completion of the reaction of combustion.

When the lines and working method for the heating chamber have been determined, its volume may be computed.

The same method of procedure is used for tempering furnaces, annealing furnaces, iron-melting furnaces, puddling furnaces, etc. ; the very first thing that is necessary is to determine the dimensions of the heating chamber and its *volume.* When the foregoing have been fixed, the composition of the furnace gases, or, more exactly, the volume of air required with reference to that theoretically required to burn the fuel, is assumed.

Calculations show that a good coal from central Russia, burned with the theoretical volume of air required, gives a theoretical calorific intensity of 2082°. With 70 per cent excess air supply this coal will give a calorific intensity of 1400°; and with double the theoretical air supply (100 per cent

excess air) the calorific intensity will be 1250°.

Now, it is evident that these temperatures can only be obtained with instantaneous combustion in an athcrmal chamber, the total amount of heat released being absorbed in raising the temperature of the gases of combustion. In reality the best means of lowering the temperature of the *jet of burning gases* is to operate the furnace so that combustion takes place with only the theoretical air supply. Such combustion requires a *certain length of time;* the combustion of the last traces of combustible gas requires a considerable amount of time in its combination with the small amount of oxygen